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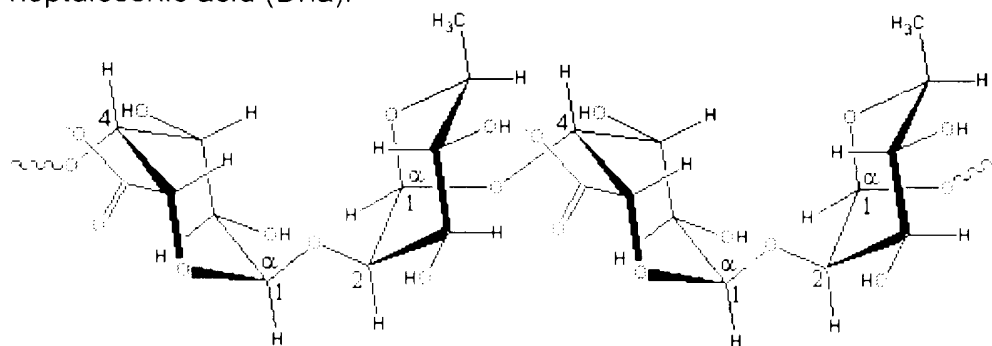
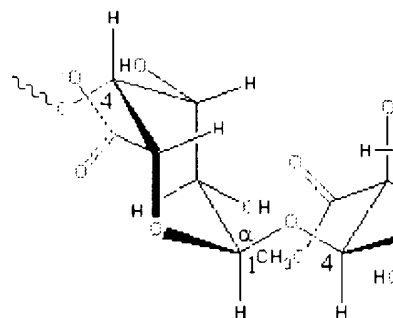
## Pectin

### Source

**Pectin** (E440) is a structural polysaccharide, found in fruit and vegetables and mainly prepared from 'waste' citrus peel and apple pomace.

### Structural unit

The majority of the structure consists of partially methylated poly- $\alpha$ -(1 $\rightarrow$ 4)-D-galacturonic acid residues ('smooth', see right) but there are substantial 'hairy' non-gelling areas (see below) of alternating  $\alpha$ -(1 $\rightarrow$ 2)-L-rhamnosyl- $\alpha$ -(1 $\rightarrow$ 4)-D-galacturonosyl sections containing branch-points with mostly neutral side chains (1 - 20 residues) of mainly L-arabinose and D-galactose but may also contain other residues such as D-xylose, L-fucose, D-glucuronic acid, D-apiose, 3-deoxy-D-manno-2-octulosonic acid (Kdo) and 3-deoxy-D-lyxo-2-heptulosonic acid (Dha).



### Molecular structure

Generally, pectins do not possess exact structures [328]. D-galacturonic acid residues form

pectins are even more flexible and may have pendant arabinogalactans. The carboxylate groups

expand the structure of pectins as a result of their charge, unless they interact through divalent bridging (their  $pK_a$  of about 2.9 [326] ensuring considerable negative charge under most circumstances). Methylation of these carboxylic acid groups forms their methyl esters, which take up a similar space but are much more hydrophobic and consequently have a different effect on the structuring of the water. The properties of pectins depend on the degree of esterification, which is normally at low methoxyl-pectins (< 40% esterified) gel by calcium divalent cation bridging between adjacent two chains forming so-called 'egg-box' junction zone structures so long as a minimum of 14-20 rings cooperate [326]. It may well be that the two carboxylate groups have to cooperate together to displace bound water away from the calcium ions to form the salt links that make up these junction zones. The gelling ability of the divalent cations is similar to that found with the alginates ( $Mg^{2+} \ll Ca^{2+}, Sr^{2+}$ ), while  $Na^+$  and  $K^+$  do not gelling. If the methoxyl esterified content is greater than about 50%, calcium ions mediate some interaction but do not gel. The similarity to the behavior of the alginates is that poly- $\alpha$ -(1 $\rightarrow$ 4)-D-galacturonic acid is almost the mirror image of poly- $\alpha$ -(1 $\rightarrow$ 4)-L-guluronic acid, the difference being that the 3-hydroxyl group is axial in the latter. The controlled removal of methoxyl groups, converting high methoxyl pectins to low-methoxyl pectins, is possible using **pectin** methyl esterase; the reverse process is not easily achieved.

High methoxyl-pectins (> 43% esterified) gel by the formation of hydrogen-bonding and hydrophobic interactions in the presence of acids and sugars.

## Functionality

Pectins are mainly used as gelling agents, but can also act as thickener, water binder and stabilizer. Low methoxyl pectins (< 50% esterified) form thermoreversible gels in the presence of calcium ions at pH (3 - 4.5) whereas high methoxyl pectins rapidly form thermally irreversible gels in the presence of sufficient (e.g. 65% by weight) sugars such as sucrose and at low pH (< 3.5); the lower the methoxyl content, the slower the set. The degree of esterification can be (incompletely) reduced using **pectin** methyl esterase, leading to a higher viscosity and firmer gelling in the presence of calcium ions. Acetylated **pectin** from sugar beet is reported to have considerable emulsification ability due to its amphiphilic nature, but this may be due to protein impurities [309].

As with other viscous polyanions such as carrageenan, **pectin** may be protective towards other colloids, enhancing the properties (foam stability, solubility, gelation and emulsification) of various systems whilst utilizing them as a source of calcium.

Interactive structures are available (COW, 'smooth' [Plug-in, ActiveX], 14 KB; 'hairy' [Plug-in, ActiveX], 14 KB; both Chime, 8 KB).

Please submit any comments and suggestions you may have.

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This page was last updated by Martin Chaplin

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